IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of	:	PATENT
Pat A. Bolen, et al.	:	Confirmation No. 5533
Serial No.: 10/721,168	:	Docket No. 115584-00343
Filed: November 26, 2003	:	Customer No. 27557
For: Flexible Flat Cable Termination Structure For A Clockspring	:	Art Unit: 2833
	:	Examiner: Harvey, James R.

DECLARATION UNDER 35 U.S.C. § 1.132

MAIL STOP AF
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Further to the Response filed concurrently herewith, I, Lawrence T. Rupert, being the Intellectual Property Manager of the Assignee, Methode Electronics, Inc., for the above-captioned patent application, hereby declare as follows:

1. This Declaration under 37 C.F.R. § 1.132 is hereby submitted to demonstrate that the present claimed invention would not have been obvious under 35 U.S.C. § 103(a) over U.S. Patent No. 5,230,713 (*Schauer*) in view Applicant's Admitted Prior Art, and further in view of U.S. Patent No. 6,032,359 (*Carroll*).

2. Attached are the following exhibits:

Exhibit A: U.S. Patent No. 5,865,634;

Exhibit B: U.S. Patent No. 6,109,942;

Exhibits C1-C3: photographs of Furukawa Electric Co. clockspring

3. Conventional clocksprings used in motor vehicles typically employ a small number of conductors. For example, two conductors are typically used for the airbag circuits and three conductors are used for other steering wheel functions, e.g. horn and speed control.

More recently, automakers have increased the quantity of steering wheel mounted control devices to include controls for the audio system, transmission shifting, telephone, etc. This trend greatly increased circuit density requirements against a backdrop of continuous price reduction demands. Thus, there has been a long-felt need for a single high circuit density cable for clocksprings to accommodate the increase in required electrical conductors.

4. The flat cables used in commercial clocksprings have traditionally employed flat copper conductors laminated between two sheets of polymer film. However, using those conventional lamination methods, the lower limit of the width of the flat copper was restricted. Because the width of the cable was restricted by the maximum thickness of a clockspring assembly, an upper limit on the quantity of parallel conductors that could be laminated in a conventional flat cable was also restricted.

5. Prominent suppliers of clocksprings have identified and attempted to solve this problem of the need for increased conductor density by use of two or more flat cables, thus allowing two or more times the amount of circuits to be used.

6. U.S. Patent No. 5,865,634 to Best (Exhibit A) describes in the "Background of the Invention" the need for increased conductor density to accommodate the increase in controls mounted on a vehicle steering wheel. See col. 1, line 61- col. 2, line 2. Best attempts to solve the problem by using at least 2 flat cables 41 and 42. See Fig. 1.

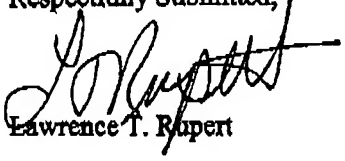
7. U.S. Patent No. 6,109,942 to Bannai (Exhibit B) also identifies the problem of the demand for increased number of electrical circuits to be connected to a clockspring. See col. 1, lines 41-43. Bannai tries to solve the need by using at least two flat cables with the clockspring. See col. 1, lines 62-64

8. Furukawa Electric Company (Exhibits C1-C3) has manufactured and employed two flat cables with its clocksprings to address the increased circuit density need.

9. Use of two flat cables at least doubles the costs of a clockspring, and significant complexity and weight are added to the clockspring. Multiple moving cables also contribute to undesirable sound emanating from the clockspring as the clockspring rotates.

10. The undersigned further declares that all statements herein made on the basis of his actual knowledge are true and that all statements herein made on information and belief are believed to be true, and that all statements herein were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the patent or any certificate of reexamination issued thereon.

Respectfully Submitted,



Dated: May 1, 2007

Lawrence T. Rupert

US005865634A

United States Patent [19]

Best

[11] Patent Number: 5,865,634

[45] Date of Patent: Feb. 2, 1999

[54] **CLOCKSPRING CONNECTOR WITH CARRIER MEMBER**

[76] Inventor: **Gary Best**, #3 Marrae Ct., Hamilton, Ill. 62341

[21] Appl. No.: **667,634**

[22] Filed: **Jun. 24, 1996**

Related U.S. Application Data

[63] Continuation of Ser. No. 276,954, Jul. 19, 1994, abandoned.

[51] **Int. Cl.**[6] **H01R 35/04**

[52] **U.S. Cl.** **439/164**; 439/15

[58] **Field of Search** 439/164, 15

[56] **References Cited**

U.S. PATENT DOCUMENTS

3,763,455	10/1973	Confer et al. .	
4,502,746	3/1985	Wawra et al. .	
4,722,690	2/1988	Priede	439/15
4,797,109	1/1989	Wende	439/15
5,046,951	9/1991	Suzuki	439/15
5,171,157	12/1992	Bolen	439/164
5,277,604	1/1994	Ida et al.	439/164
5,310,356	5/1994	Obata et al.	439/15
5,328,112	7/1994	Obata	242/388

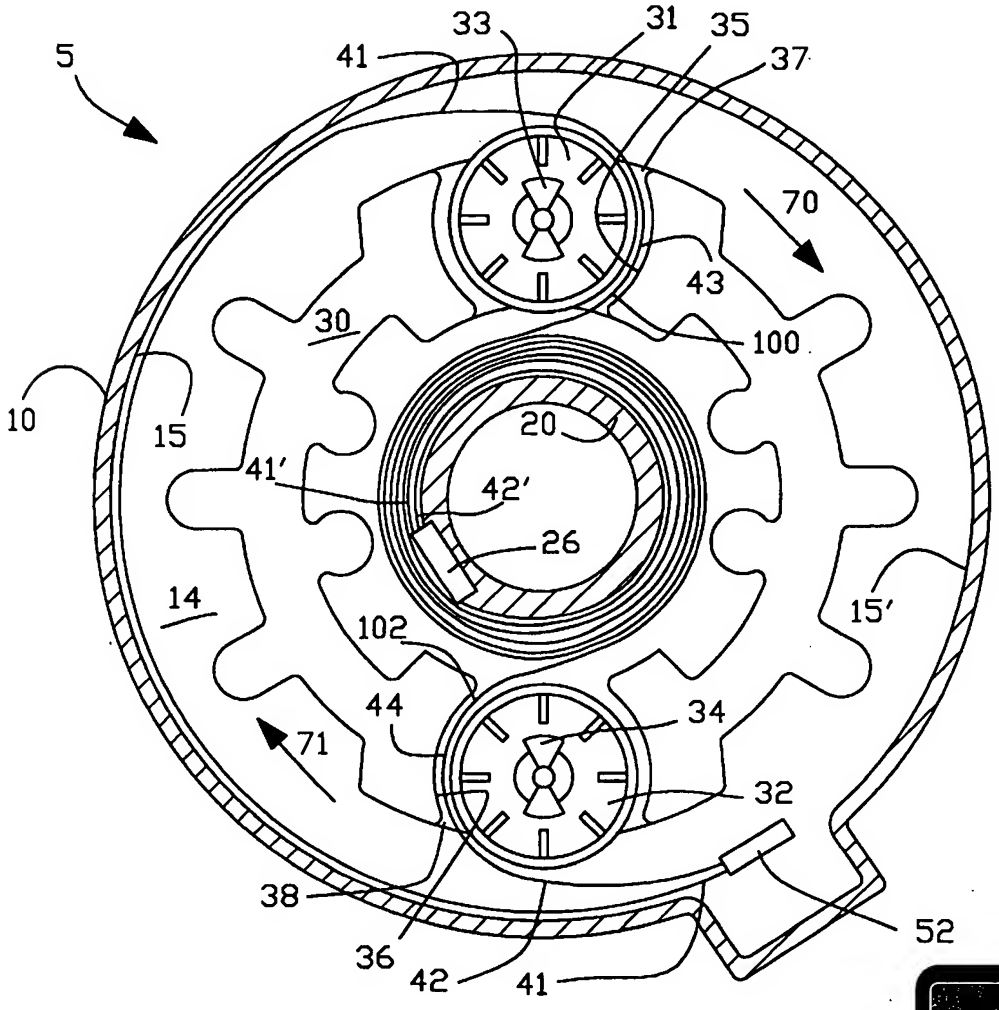
Primary Examiner—Gary F. Paumen

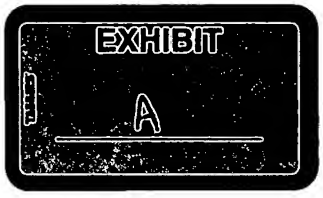
Attorney, Agent, or Firm—David L. Newman

[57] **ABSTRACT**

A clockspring connector is provided comprising a housing defining a chamber, including a carrier member having a first roller associated with a first turned-back loop of a first flat conductor cable and a second roller associated with a second turned-back loop of a second flat conductor cable wherein said first and second flat conductor cables are alternatingly coiled at an inner diameter of the chamber adjacent the hub or along said outer diameter of the chamber adjacent the housing wall.

17 Claims, 3 Drawing Sheets





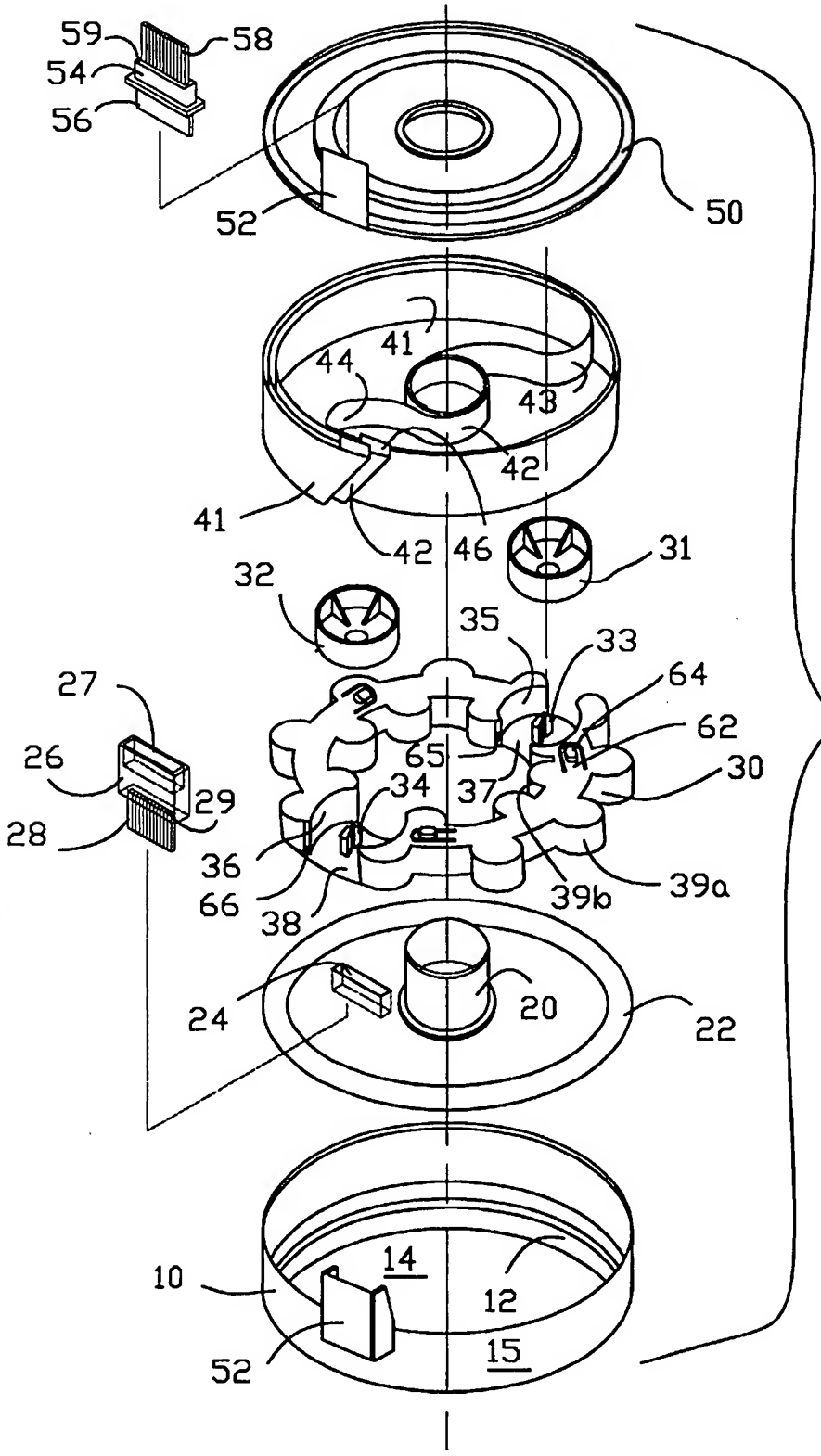

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Fig. 1

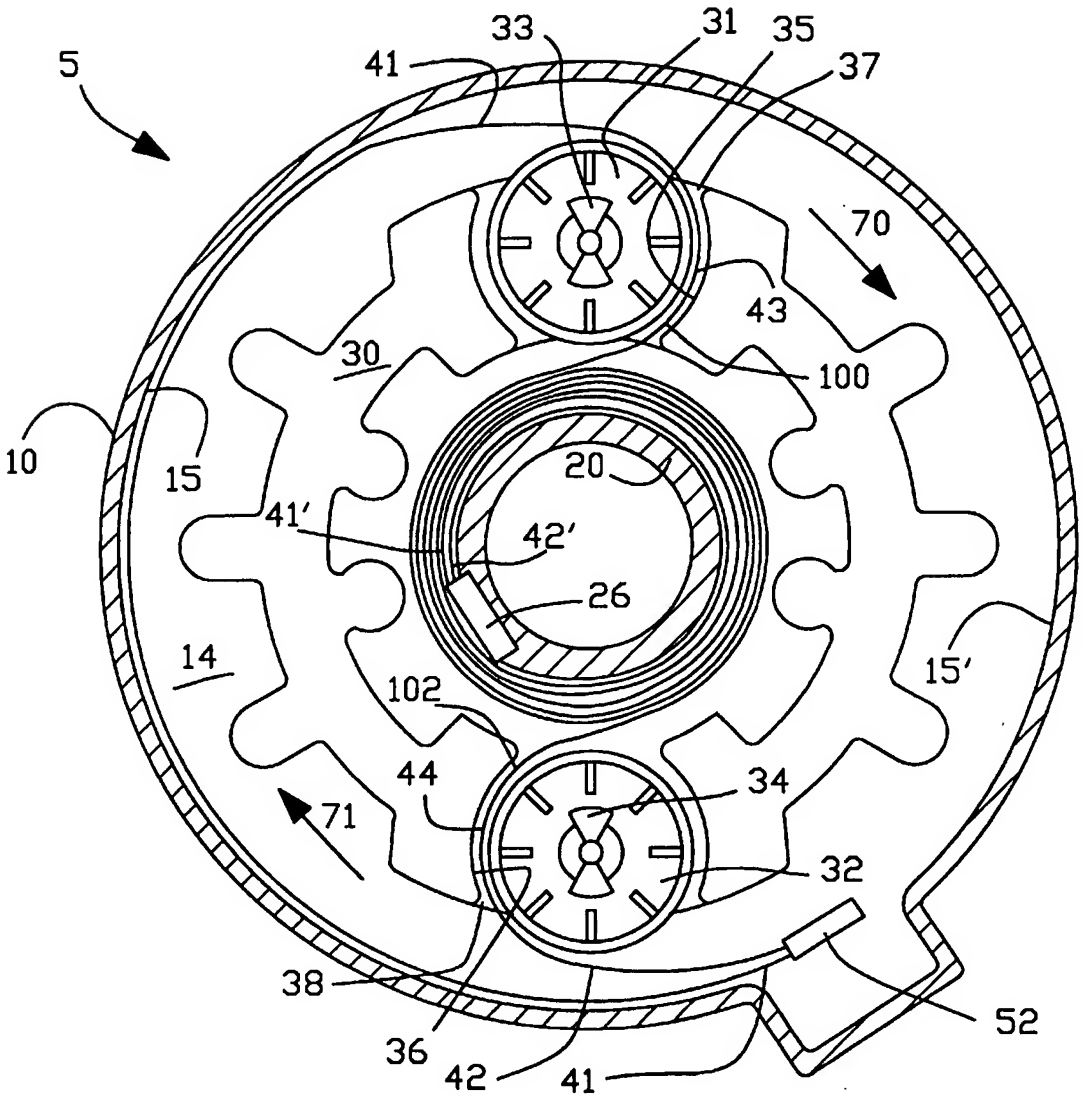
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Fig. 2

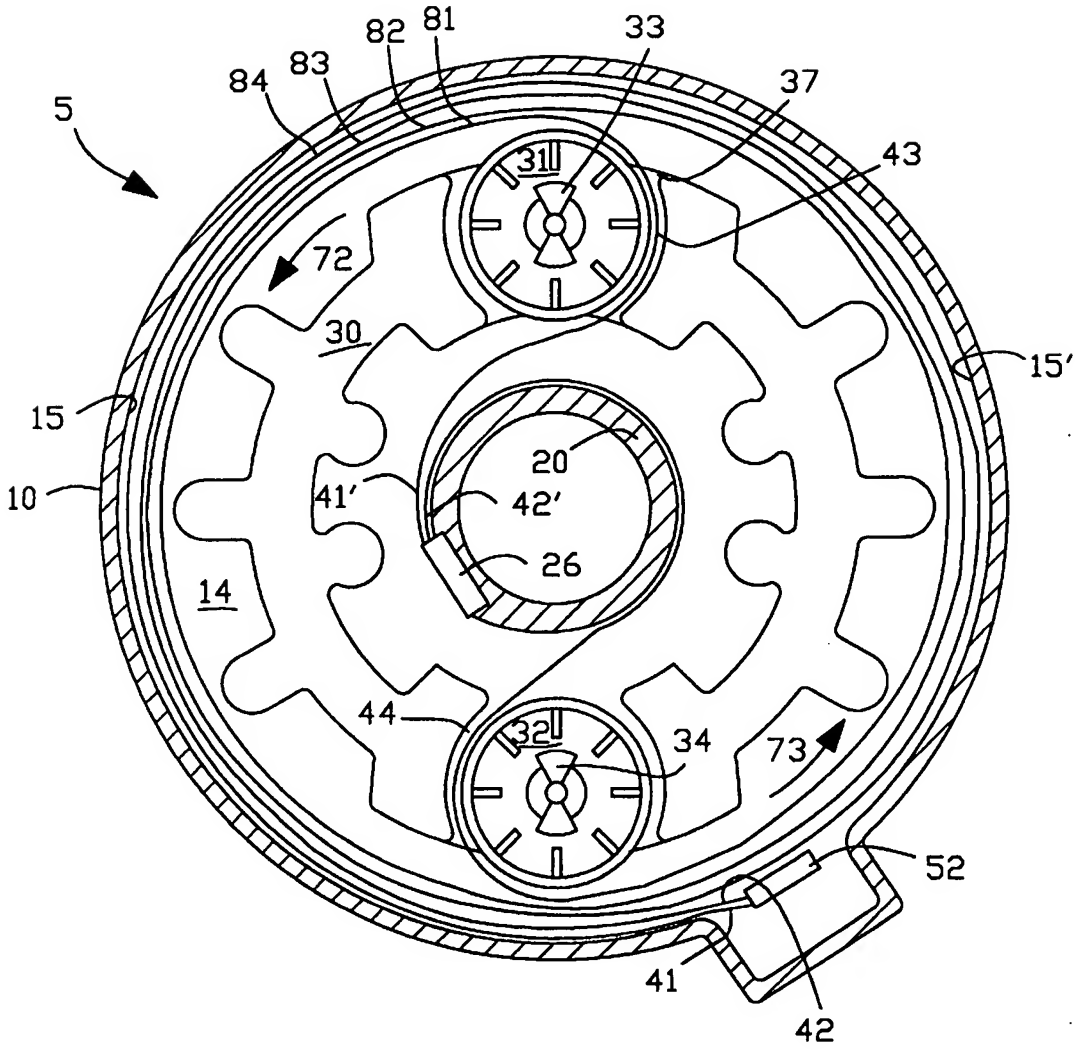
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Fig. 3

CLOCKSPRING CONNECTOR WITH CARRIER MEMBER

This is a continuation of application Ser. No. 08/276,954, filed Jul. 19, 1994, now abandoned.

BACKGROUND OF THE INVENTON

This invention pertains to a clockspring connector for enclosing electrical conductor cables, the clockspring connector electrically connecting a rotatable electric device with a stationary electric device.

While the present invention may have multiple applications, the most prevalent is for use in automobiles. An increasing number of automobiles have airbag crash systems. An airbag is typically located on the steering wheel facing the driver. The airbag must be in continuous electrical connection with sensors in the car body. The sensors provide an electrical signal to the airbag crash assembly which instantly inflates the airbag in the event of a crash. Accordingly, there is a need for an electrical connection between the rotatable portion of the airbag assembly which is mounted to the steering wheel, and the remaining portion of the assembly which is in a stationary position in the car body. Electrical connections between rotatable and stationary parts are well known. Typically, an electrical brush rests upon a conductive ring, with one of the parts being rotatable to provide such rotatable electrical connection. However, there is a risk, particularly during the impact of an accident, of a transient failure of electrical connection with a brush and ring system which result in failure of the entire airbag system crash assembly.

Accordingly, a clockspring connector has previously been developed, comprising an outer housing, a rotor member and a multiple of intermediate housing members for enclosing and connecting the members; the housing and rotor member rotatably associated with one another at a plurality of bearing surfaces. A "clockspring" is located inside the interconnector. The clockspring of prior art devices includes a single flat conductor cable having its ends conductively attached to conductor wires which pass out of the interconnector to unite the airbag to the sensing device. For example, U.S. Pat. No. 5,061,195 discloses a clockspring housing and assembly having a single flat conductor cable therein.

It has also been known in the art to reduce the length of the flat conductor cable in order to reduce cost and needed space within the clockspring housing. For example, U.S. Pat. No. 5,277,604 incorporates an assembly of at least eight rollers and turned-back portions of the flat conductor cable within the clockspring housing to decrease the length of the flat cable and also prevent buckling and enhance reliability and smooth rotation of the clockspring connector. Such a design requires a complex and expensive system of mounting the rollers. Such a design may be expensive and, as well, only accommodates a single flat conductor cable.

The use of a pair of conductor cables was disclosed in U.S. Pat. No. 3,763,455. The conductor cables were carried by an assembly of twenty spacers or rollers. This design also requires a multiplicity of parts, including numerous rollers which add to the assembly time and costs of the device.

As more controls are mounted on the steering wheel, more conductors are required to pass multiple electrical signals through the clockspring connector. Prior art clocksprings have included conductor cables having up to six conductors in each flat cable. The excess of six conductors is limited by the limited width of the flat conductor cable and the processing methods of manufacturing the flat cable.

Accordingly, there is needed a clockspring connector which can accommodate more than six conductors.

It is another object of the present invention to provide a clockspring connector having a minimal amount of moving parts.

It is a further object of the present invention to provide a clockspring connector having flat conductor cable of minimal length.

It is another object of the present invention to provide a clockspring having a freely and independently rotating carrier member.

SUMMARY OF THE INVENTION

The above objects and advantages are provided by a clockspring connector comprising a housing defining a chamber extending therethrough. A carrier member positioned within the chamber having two rollers. Flat conductor cable carried by the carrier member. The flat conductor cable having a first turned-back loop section associated with a first roller and a second turned-back loop section associated with a second roller. A first flat cable associated with the first roller and a second flat cable associated with the second roller. A hub having an inner diameter exit cavity for receiving the flat conductor cable. Whereupon rotation of the hub in a clockwise direction causes the first flat conductor cable to unwind from the hub and push against the carrier wall adjacent the first roller and simultaneously the second flat cable unwinds off of the hub and pushes against the second wall of the carrier member adjacent the second roller causing the carrier member to rotate in a clockwise direction and to transfer the first and second flat cables from the hub to the outer diameter of the housing. Rotation of the hub in the counterclockwise direction causes the first flat cable to pull on the first roller and the second flat cable to pull on the second roller causing the first and second flat cables to unwind from the outer diameter of the chamber and simultaneously causing the carrier member to rotate in a counterclockwise direction.

A housing member receives the hub, the carrier member is mounted on the hub, and a cover encloses the carrier member and flat cables within the housing. The cover having an outer diameter exit cavity.

These and other features of the invention are set forth below in the following detailed description of the presently preferred embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an exploded perspective view of a clockspring connector;

FIG. **2** is a top view of a clockspring connector in a fully wound position; and

FIG. **3** is a top view of clockspring connector in a fully unwound position.

DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENTS

The clockspring connector of this invention is better understood by references to FIGS. **1–3** which show various aspects of a presently preferred clockspring connector. Turning to FIG. **1**, a housing **10** receives a hub **20**. Mounted on the hub is a carrier member **30**. A first flat conductor cable **41** and a second flat conductor cable **42** is carried by the carrier member **30**. A cover **50** encloses the flat cables **41,42**, carrier member **30** and hub **20** within housing **10**.

The housing **10** includes a ledge **12** upon which the base **22** of hub **20** rests. The hub **20** and housing **10** are con-

structed of materials which allow the hub **20** to freely rotate within the housing **10** and to reduce the amount of friction between the base **22** and ledge **12** to the greatest extent. Materials such as a teflon tape, silicon material or grease may be inserted between the base **22** and ledge **12** in order to reduce friction at these bearing surfaces and all other bearing surfaces of the present invention. An inner diameter exit cavity **24** protrudes downwardly from the base **22** of hub **20**. Inserted within the inner diameter exit cavity **24** is inner diameter backbone **26**. The inner diameter backbone **26** receives flat conductor cable at its entrance end **27** and insulated wires **28** protrude from the exit end **29**.

Mounted on the hub **20** and freely and independently rotatable thereon is carrier member **30**. The carrier member **30** is generally a spherically shaped member being molded of a thermoplastic polymer material in the presently preferred embodiment. However, any material may be used to form the carrier member **30**. The carrier member **30** includes a first roller mounting area **37** and a second roller mounting area **38**. Axles **33,34** protrude upwardly from the roller mounting areas **37,38**, respectively. Roller area walls **35,36** surround the roller areas **37,38** and are correspondingly shaped to the outer diameter of first roller **31** and second roller **32**. Inner diameter corner **65** and outer diameter corner **66** are located at each end of roller area walls **36,36**. The total circumference of roller area walls **36,36** may be controlled by changing the shape of corners **65,66** in order to control the path of the conductor cables **41,42**. By rounding corners **65,66**, the circumference of walls **35,36** is reduced and the area which contacts the conductor cables **41,42** is also reduced. By extending and bringing corners **65,66** to a point, the circumference of walls **35,36** is increased which increases the surface area which contacts conductor cables **41,42**.

First roller **31** is mounted on axle **33** and second roller **32** is mounted on axle **34** of the carrier member **30**. The first and second rollers **31,32** rotate freely and independently on their axles **33,34**. A multiplicity of nubs **39***a* and **39***b* protrude from around the carrier member **30** toward the hub **20** or housing wall **15** and provide a surface against which the conductor cables **41,42** may rub and rotate against. The carrier member **30** provides a member for mounting rollers **31,32** and separating the conductor cables **41,42** along the outer diameter of the chamber **14** from the conductor cables **41,42** at inner diameter of the chamber **14**. Spring members **62** are molded into the carrier member **30**. Spacers **64** protrude from spring members **62** and help to keep the carrier member **30** positioned axially within the clockspring housing chamber **14**. The housing chamber **14** is defined by the housing wall **15** around the circumference of the housing **10**. The chamber **14** is further defined by the hub base **22** at its bottom and cover **50** at the top.

The present invention includes two flat conductor cables. A first conductor cable **41** and second conductor cable **42** are adjacently coiled around carrier member **30** within chamber **14** of the housing **10**. The flat cables **41,42** of a preferred embodiment of this invention are formed by laminating six conductors parallel to each other with a pair of insulating films one each side. The use of two flat cables **41,42** having six conductors each provides for a total of twelve conductors carried by the preferred embodiment of this invention. It is within the scope of the present invention that more than two conductor cables could be carried by the present embodiment in order to increase the number of conductors to an almost limitless combination. The first conductor cable **41** includes first turned-back U-shaped loop section **43** and second conductor cable **42** includes second turned-back U-shaped loop section **44**. First and second conductor cables **41,42** exit the clockspring at the outer diameter through the outer diameter exit cavity **52**. Conductor cable tails **46** are folded perpendicularly to the path of the conductor cables within the chamber **14** and are received by the outer diameter exit cavity **52**. Outer diameter backbone **54** is received from the other end of the outer diameter exit cavity **52** from the conductor cable tails **46**. Entrance cavity **56** of the outer diameter backbone **54** receives the first and second conductor cables **41,42**. The conductors of the cables **41,42** are welded to the corresponding insulated wires **58** which protrude from the exit end **59** of outer diameter backbone **54**.

Assembly of the clockspring connector having the hub **20** adjacent the housing **10** occurs in order to allow for the easiest and quickest possible assembly of the clockspring connector. While the hub **20** includes the exit cavity **24** at the inner diameter, the hub **20** is the rotatable member which is associated with the steering wheel of an automobile. Rotation of the steering wheel of the automobile simultaneously rotates the hub **20**. The cover **50** having exit cavity **52** at its outer diameter is placed onto the housing **10** and is the stationary member of the clockspring connector. The exit cavity **52** at the outer diameter is associated with the steering column of an automobile and is stationary. Thus, although FIG. **1** shows assembly of the clockspring connector having the inner diameter exit cavity **24** on the bottom and the outer diameter cavity **52** at the top of the assembly; when the clockspring connector is assembled to a steering assembly, it will be inverted so that the inner diameter exit cavity **24** and hub **20** are on the top of the clockspring connector and the outer diameter exit cavity **52** and cover **50** are on the bottom of the clockspring connector.

Operation of the clockspring can more easily be understood by viewing FIG. **2**. The housing **10** has mounted therein carrier member **30** and hub **20**. Mounted on the carrier member **30** is first roller **31** and second roller **32**. The clockspring connector is shown in the fully wound position having the majority of the conductor cables **41,42** coiled around the hub **20** at the inner diameter of the chamber **14**. First roller **31** is mounted in roller area **37** on axle **33** of the carrier member **30**. Second roller **32** is mounted in second roller area **38** on axle **34** of the carrier member **30**. First conductor cable **41** exits the outer diameter backbone **54** and coils adjacent to the outer diameter wall **15** of the housing **10**. First turned-back loop section **43** then coils around first roller **31** and then coils around the hub **20**. Second flat conductor cable **42** exits the outer diameter backbone **52** and at second turned-back loop **44**, coils around second roller **32** and then onto hub **20** from the opposite side, 180° from the position where the first conductor cable **41** coils onto the hub **20**. First conductor cable **41'** terminates at the inner diameter backbone **26**, adjacent second flat conductor cable **42'**.

The rotational movement of the steering wheel is transmitted to the clockspring connector through the hub **20** and inner diameter backbone **26**. Rotation in the clockwise direction or in direction of arrows **70,71** causes the first flat conductor cable **41** to unwind off of hub **20** and move to the right at position **100** and rub against wall **35** of the first roller area **37** of the carrier member **30**. Simultaneously, second flat conductor cable **42** unwinds from hub **20** at point **102** and protrudes and rubs against wall **36** of second roller area **38** of carrier member **30**. As the hub continues to unwind in the clockwise direction, the conductor cables **41,42** push against walls **35,36** and force the carrier member **30** also to rotate clockwise. As the hub **20** and carrier member **30** rotate clockwise, the first flat conductor cable **41** is spooled out from first roller **31** to completely encircle the outer diameter

of the chamber **14** adjacent the wall **15** of the housing **10**. Simultaneously, the second flat conductor **42** is spooled out along second roller **32** at a position 180° from the first conductor cable **41**, to provide a second coil layered adjacently to the first conductor cable **41** at the outer diameter of the chamber **14**. Rotation of the hub and carrier member **30** continue in the clockwise direction until the flat cables **41,42** are completely unwound from the hub **10**.

The completely unwound condition is shown in FIG. **3**. Like numerals for like elements of FIG. **2** are shown in FIG. **3**. The clockspring connector **5** is shown in a completely unwound position, i.e., the flat conductor cables **41,42** are not coiled around hub **20**. To wind the clockspring connector, the hub **20** is rotated in a counter-clockwise direction in the direction in the direction of arrows **72,73**. Upon rotation of the hub **20** in a counter-clockwise direction, the first flat cable **41** pulls on the first roller **31** at first turned-back loop **43** causing the first roller **31** to rotate. Simultaneously, second conductor cable **42** pulls on second roller **32** at second turned-back loop **44** causing the second roller **32** to rotate in clockwise direction. The pulling of the first cable **41** and the second cable **42** on the first and second rollers **31,32** causes the carrier member **30** to rotate in a counter-clockwise direction. As the hub **20** and carrier member **30** continue to rotate counter-clockwise, the first and second conductors **41,42** are uncoiled from the outer diameter of the chamber **14** and become coiled again onto the hub **20**. It can be seen that in the completely unwound position, the coils are positioned along the outer diameter of the chamber **14** in a first layer **81**, a second layer **82**, a third layer **83**, and a fourth layer **84**. The first conductor cable **41** and the second conductor cable **42** are alternatingly layered; wherein first layer **81** and third layer **83** are the first conductor cable **41** and the second layer **82** and fourth layer **84** are the second conductor cable **42**. Upon the first rotation of the hub **20** in the counter-clockwise direction, layer **81** is taken up from the outer diameter of the chamber onto the hub **20** by first roller **31**. Simultaneously, second layer **82** is taken up by second roller **32**. Upon a second rotation, third layer **83** is taken up by the continued rotation of first roller **31** in the counter-clockwise direction and fourth layer **84** is taken up by second roller **32**. This alternating take-up sequence is correspondingly achieved along the inner diameter of the chamber **14** by winding the clockspring connector in the clockwise direction spooling first and second conductor cables **41,42** onto the hub **20**.

It can be seen from the present invention that two flat conductor cables can be easily wound with minimal components incorporated within the clockspring housing and with minimal length of flat conductor cable. It should be understood that various changes and modifications to the presently preferred embodiments described herein will be apparent to those skilled in the art. Such changes and modifications may be made without departing from the spirit and scope of the present invention and without diminishing its attendant advantages. It is, therefore, intended that such changes and modifications be covered by the appended claims.

What is claimed is:

1. A clockspring connector comprising:

a clockspring housing;

a hub mounted within said housing;

a chamber defined by said housing;

a carrier member within said housing having a first roller and a second roller each mounted at a roller area having carrier member walls, said walls being fixed relative to said carrier member and partially surrounding said first and second rollers and closely adjacent a first turned-back loop and a second turned-back loop, respectively;

a first flat conductor cable having said first turned-back loop associated with said first roller; and

a second flat conductor cable having said second turned-back loop associated with said second roller wherein rotation of said clockspring connector causes said first and second flat conductor cables at said first turned-back loop and said second turned-back loop to abut against said carrier member walls and cause the carrier member to rotate within said housing.

2. The clockspring connector of claim **1** wherein:

said hub includes an inner diameter exit cavity.

3. The clockspring connector of claim **1** wherein said housing includes an outer diameter exit cavity.

4. The clockspring connector of claim **1** wherein said carrier member is carried by said hub.

5. The clockspring connector of claim **1** wherein:

a base portion protrudes from said hub and said carrier member supported on said base portion.

6. The clockspring connector of claim **1** wherein:

said inner diameter exit cavity receiving said first and second flat conductor cables.

7. The clockspring connector of claim **1** wherein:

said outer diameter exit cavity receiving said first and second flat conductor cables.

8. The clockspring connector of claim **1** including:

a cover enclosing said housing and defining said chamber therein.

9. The clockspring connector of claim **1** wherein:

said inner diameter exit cavity receives a backbone;

said backbone having an entrance end and an opposed exit end;

said entrance end receiving said first and second flat conductor cables; and

said exit end having insulated wires extending therefrom.

10. The clockspring connector of claim **1** including:

said outer diameter exit cavity having a backbone having an entrance end and an exit end;

said entrance end receiving said first and said second flat conductor cables; and

said exit end having insulated wires exiting therefrom.

11. The clockspring connector of claim **1** wherein:

rotation of said hub from an unwound position causes said first flat conductor cable to be wound from the outer diameter of said chamber through said first turned-back loop around said first roller and wound onto said hub and simultaneously said second flat conductor cable being wound from said outer diameter of said chamber through said second turned-back loop around said second roller and wound onto said hub, alternatingly coiled with said first flat conductor cable; and

rotation of said hub from its wound position causes said first flat conductor cable to be unwound from said hub through said first turned-back loop around said first roller to said outer diameter of said chamber and simultaneously said second flat conductor cable being unwound off of said hub through said second turned-back loop around said second roller to said outer diameter of said chamber, alternately coiling said second flat conductor cable with said first flat conductor cable between a housing wall and said carrier member.

12. The clockspring connector of claim 11 wherein: said first and second flat conductor cables are coiled at a second outer diameter of said chamber between said housing and nubs of said carrier member.

13. The clockspring connector of claim 1 wherein:

said hub is mounted upon a lip of said housing forming a first side of said chamber; and

a cover mounted on said housing defining a second side of said chamber.

14. The clockspring connector of claim 1 wherein:

said flat conductor cables comprising twelve conductors.

15. The clockspring connector of claim 1 wherein:

said first conductor cable alternatingly coiled with said second conductor cable.

16. The clockspring connector of claim 1 wherein:

said first and second rollers are freely and independently rotatable from said carrier member.

17. The clockspring connector of claim 1 wherein:

said carrier member is freely and independently rotatable from said housing and said hub.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 5,865,634
DATED : February 2, 1999
INVENTOR(S) : Gary Best

It is certified that error appears in the above-indentified patent and that said Letters Patent is hereby corrected as shown below:

On title page, add item [73]

ASSIGNEE: Methode Electronics, Inc.

ADDRESS: Chicago, IL

Signed and Sealed this

Fifth Day of October, 1999

Attest:

Attesting Officer

Q. TODD DICKINSON

Acting Commissioner of Patents and Trademarks

US006109942A

United States Patent [19]

Bannai

[11] Patent Number: 6,109,942

[45] Date of Patent: Aug. 29, 2000

[54] **ROTARY CONNECTOR**

[75] Inventor: **Hiroyuki Bannai**, Miyagi-ken, Japan

[73] Assignee: **Alps Electric Co., Ltd.**, Tokyo, Japan

[21] Appl. No.: **09/303,001**

[22] Filed: **Apr. 30, 1999**

[30] **Foreign Application Priority Data**

May 6, 1998 [JP] Japan 10-123515

[51] **Int. Cl.**[7] **H01R 3/00**

[52] **U.S. Cl.** **439/164**; 439/15

[58] **Field of Search** 439/15, 164

[56] **References Cited**

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FOREIGN PATENT DOCUMENTS

695 000 A2 1/1996 European Pat. Off. .

OTHER PUBLICATIONS

Japanese Utility Model Publication No. 4–24611, dated Jun. 10, 1992.

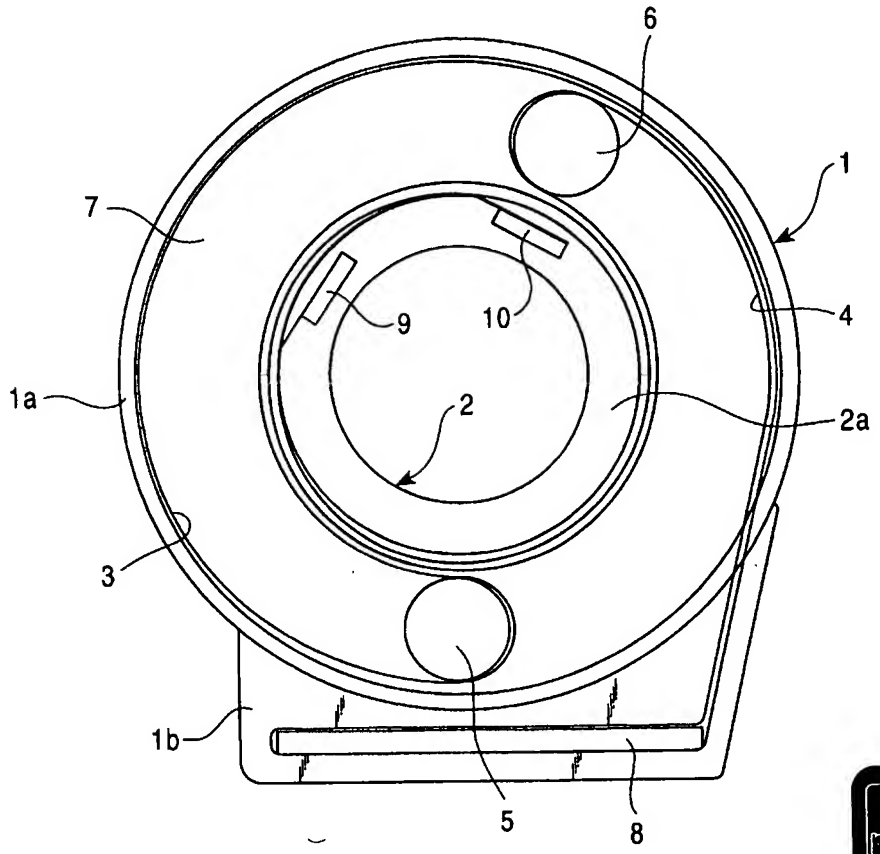
Primary Examiner—Khiem Nguyen

Attorney, Agent, or Firm—Brinks Hofer Gilson & Lione

[57] **ABSTRACT**

A rotary connector which uses two flat cables and simplifies a process of connecting both the flat cables to a lead block. In this rotary connector, a through hole and a pair of window holes are formed in a supporting element of an outer lead block. Left-hand side and right-hand side groups of a plurality of joint bars are exposed in the window holes. Necessary first and second flat cables are preliminarily connected to one another into a flat cable. Further, each of conductors placed near this flat cable is exposed. Furthermore, the exposed portion of each of the conductors is made to overlap with the exposed portion of a corresponding one of joint bars, which are exposed in both the window holes of the outer lead block. The conductors are connected to the joint bars at two connection portions placed in a direction, in which the conductors extend, by ultrasonic-welding or spot-welding. Subsequently, the conductors exposed to the through hole are cut and divided into those connected to the two flat cables and that are electrically independent of each other.

6 Claims, 3 Drawing Sheets



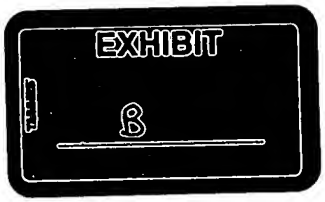


FIG. 1

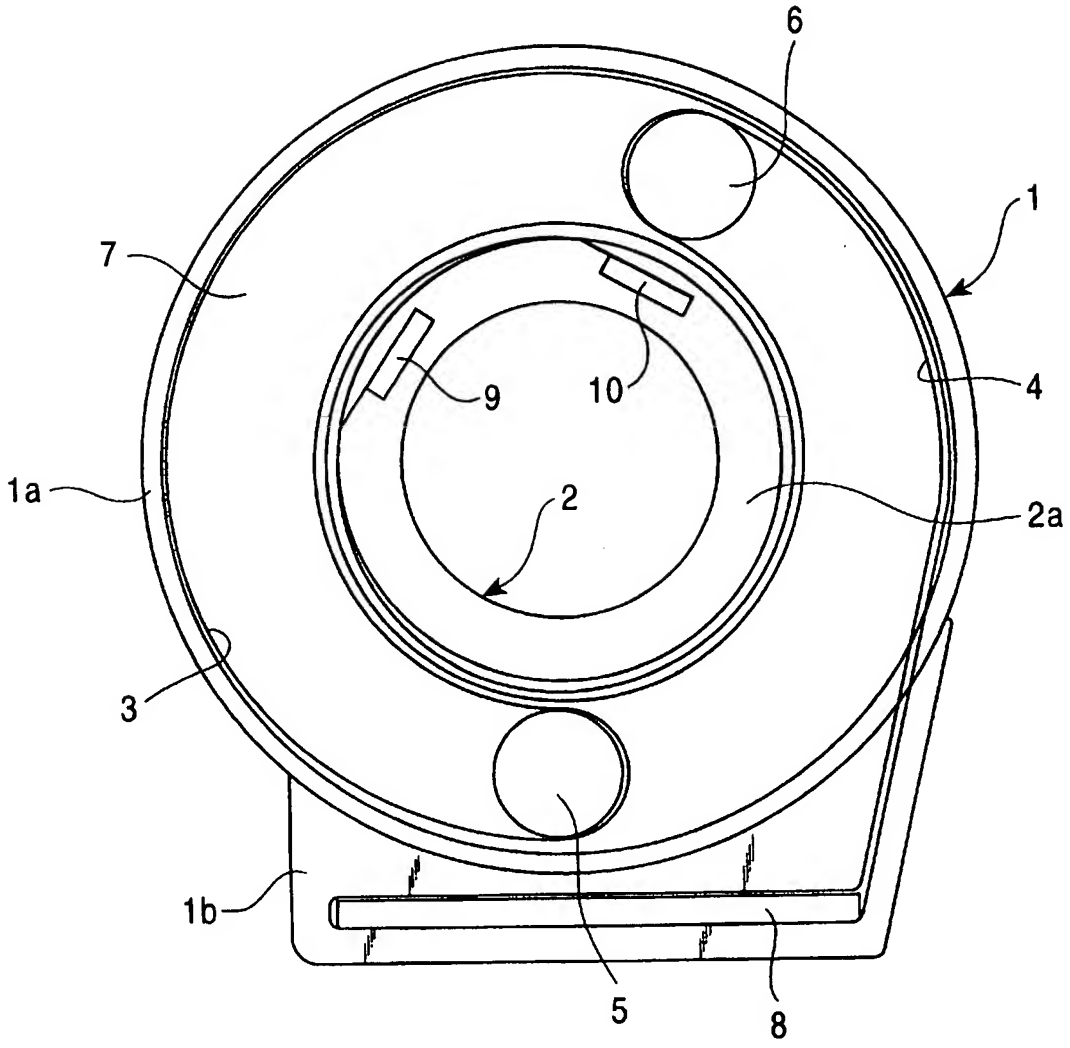


FIG. 2

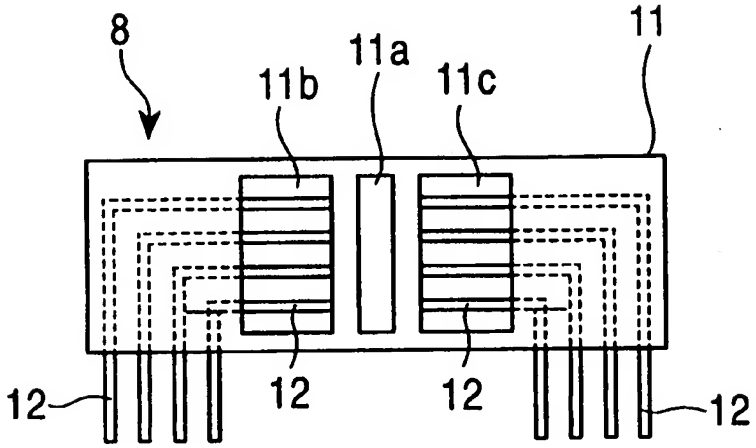


FIG. 3

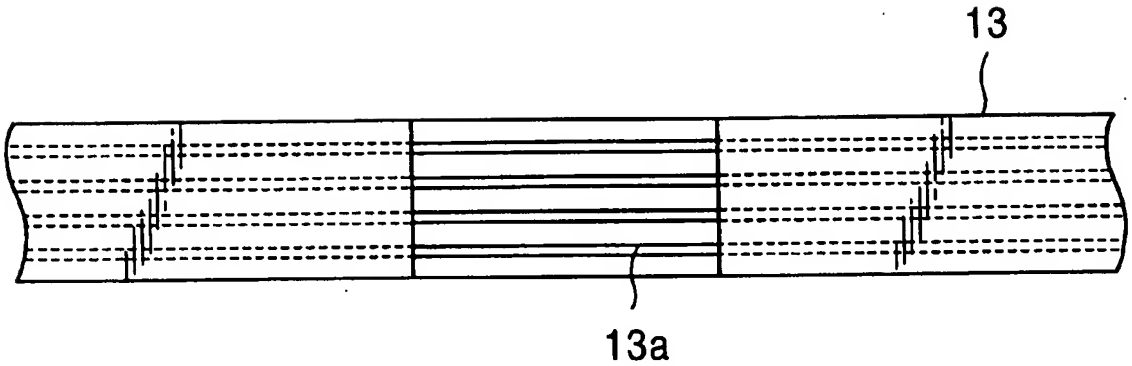


FIG. 4

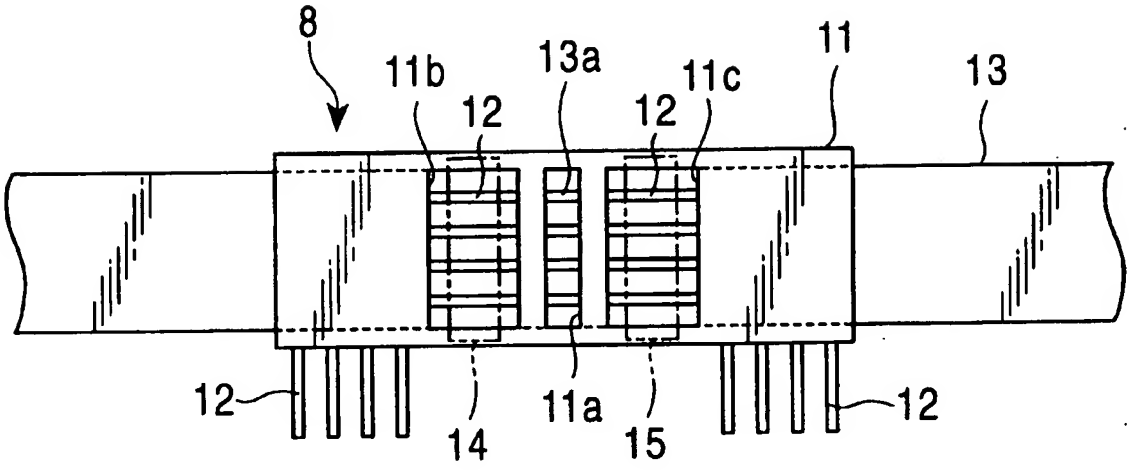
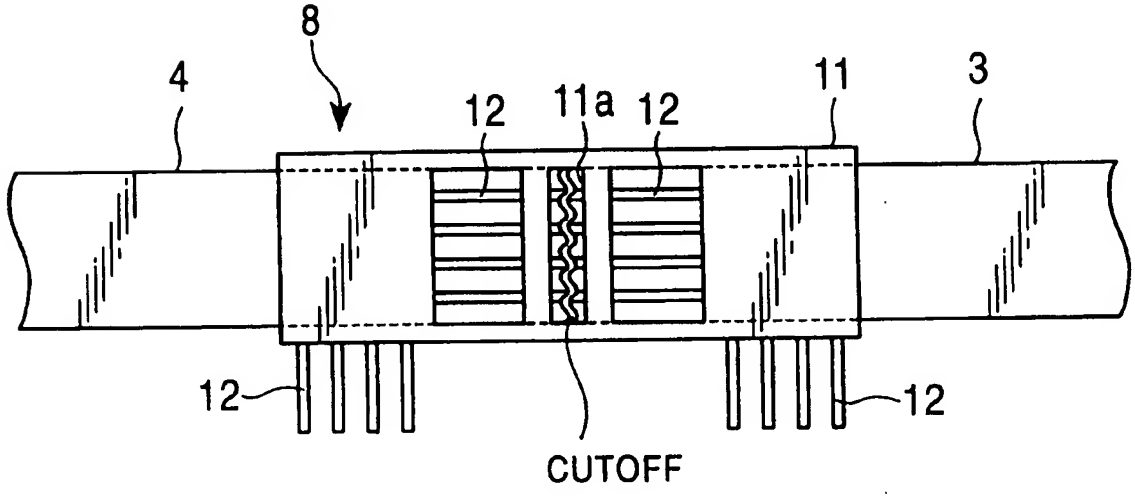

8
11b
13a
11c
11
13
12
12
12
11a
12
14
15

FIG. 5


8
4
12
11a
12
11
3
12
12
CUTOFF

ROTARY CONNECTOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention generally relates to a rotary connector to be used as an electrical connection means for an airbag system and so on. More particularly, the present invention relates to a rotary connector of the type that leads a flat cable accommodated in a space defined between a pair of housings to the exterior through a lead block.

2. Description of the Related Art

A rotary connector broadly comprises a pair of housings connected in such a way as to be concentric with and rotatable with respect to each other and a flat cable accommodated in a space defined between these housings. The ends of flat cable respectively fixed to these housings are electrically led to the exterior of the space. One of the housings is used as a stationary member, while the other is used as a movable member. When the movable housing is rotated clockwise or counterclockwise with respect to the stationary housing, the flat cable is wound or unwound in the space.

The rotary connector broadly configured in this manner is used as an electrical connection means for an airbag system and a horn circuit by respectively attaching the stationary housing and the movable housing to a stator member, such as a steering column, and a steering wheel acting as a rotor member. At that time, both the ends of the flat cable need to be connected to the stator member and an electric component mounted on the steering wheel. A rotary connector disclosed in the Japanese Utility Model Publication No. 4-24611 Official Gazette is configured so that both the ends of the flat cable are electrically led to the exterior through a lead block fixed to the housings. This lead block has a plurality of joint bars supported by insulating members. The lead block and the flat cable are accurately positioned in the connector. In this state, each of the joint bars is ultrasonically welded to a corresponding conductor. Then, the lead block is fixed at a predetermined place in the housing.

Meanwhile, in recent years, there have been demands for increasing the number of electrical circuits to be connected by a rotary connector. A rotary connector adapted to accommodate two flat cables in the space defined between the housings as described in the European Patent Application Publication No. EP0695000A2 is proposed as one supporting multi-circuit applications. However, in the case of using two flat cables, a lead block needs to be connected to each of the flat cables. Such a connecting operation involves a high-precision positioning process. This raises the problem that a process of manufacturing an entire rotary connector is very complex.

SUMMARY OF THE INVENTION

Accordingly, an object of the present invention is to provide a rotary connector that solves the problem of the conventional rotary connector.

To achieve the foregoing object, according to the present invention, there is provided a rotary connector which comprises a pair of housings that are coaxially and relatively rotatably connected to each other, two flat cables accommodated in a space defined between these housings, and a lead block fixed to the housings. At least one end portion of each of conductors of the aforesaid flat cables is led to the exterior of the aforesaid housings through joint bars supported by the aforesaid lead block. Joint bars, the number of which is more than that of the conductors of a single flat cable, are provided on the common lead block. The conductors of the single flat cable are connected to the aforesaid joint bars at two connection portions placed in a direction in which the conductors extend. Subsequently, the single flat cable is divided into two flat cables, which are electrically independent of each other, by cutting the aforesaid conductors between these connection portions.

In the rotary connector configured as described herein-above, the lead block may be divided into two lead blocks when the single flat cable is divided into two flat cables. Each of the two lead blocks are connected to a corresponding one of the two flat cables. Thus, the degree of flexibility in placing the lead blocks in the housings is increased.

Further, in the rotary connector constructed as described herein-above, the common lead block may be maintained as one piece without being cut when the single flat cable is divided into the two flat cable. In this case, one lead block is connected to the two flat cables. Thus, an operation of fixing the lead block to the housings is accomplished at a time.

Other features, objects and advantages of the present invention will become apparent from the following description of a preferred embodiment with reference to the drawings in which like reference characters designate like or corresponding parts throughout several views.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view schematically illustrating a rotary connector embodying the present invention;

FIG. 2 is a plan view of an outer lead block;

FIG. 3 is a plan view of a flat cable in the state before the cable is divided;

FIG. 4 is a plan view illustrating a state in the midst of a process of connecting the outer lead block and the flat cable; and

FIG. 5 is a plan view illustrating a state after the outer lead block is connected to the flat cable.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Hereinafter, the preferred embodiment of the present invention will be described in detail by referring to the accompanying drawings. FIG. 1 is a plan view schematically illustrating a rotary connector. FIG. 2 is a plan view of an outer lead block. FIG. 3 is a plan view of a flat cable in the state before the cable is divided. FIG. 4 is a plan view illustrating a state in the midst of a process of connecting the outer lead block and the flat cable. FIG. 5 is a plan view illustrating the state after the outer lead block is connected to the flat cable.

As shown in FIG. 1, the rotary connector embodying the present invention broadly comprises a stationary housing 11, a movable housing 2 rotatably attached to the stationary housing 1, first and second flat cables 3 and 4 accommodated between these housings 1 and 2, and a pair of rollers 5 and 6 around which the turned-back loop portions of the flat cables 3 and 4 are respectively wound. The stationary housing 1 has a cylindrical outer ring wall 1*a*. The movable housing 2 has a cylindrical inner ring wall 2*a*. A ring-like cable-accommodating portion 7 is defined between the outer ring wall 1*a* and the inner ring wall 2*a*. For convenience of description, the cable-accommodating portion 7 is illustrated in FIG. 1 as being opened at the top and bottom ends. Actually, the cable-accommodating portion 7 is covered by

the stationary housing **1**. A movable element (not shown) is rotatably placed in this cable-accommodating portion **7**. Both the rollers **5** and **6** are rotatably supported by the movable element. A holding portion **1***b* protruding outwardly from the aforementioned outer ring wall **1***a* is formed thereon. An outer lead block **8** is fitted into and fixed to a groove provided in this holding portion **1***b*. As will be described later, the outer ends of the first and second flat cables **3** and **4** are connected to the outer lead block **8**. The outer ends of the flat cables **3** and **4** are electrically led to the exterior of the stationary housing **1** through this outer lead block **8**. On the other hand, the inner ends of the flat cables **3** and **4** are connected to the inner lead blocks **9** and **10** fixed to the inner ring wall **2***a*, respectively. Thus, the ends of the cables **3** and **4** are electrically led to the exterior of the movable housing **2** through these inner lead blocks **9** and **10**.

When, for example, the movable housing **2** is rotated clockwise in the rotary connector constructed in the aforementioned manner, as viewed in FIG. **1**, the turned-back portions of the flat cables **3** and **4** move the cable-accommodating portion **7** clockwise by an amount of rotation, which is less than that of the movable housing **2**. The winding condition of the flat cables **3** and **4** is a wound condition where a larger amount of cable is placed at the side of the inner ring wall **2***a*. Conversely, when the movable housing **2** is rotated counterclockwise, as viewed in FIG. **1**, the turned-back portions of the flat cables **3** and **4** move the cable-accommodating portion **7** counterclockwise by an amount of rotation, which is less than that of the movable housing **2**. The winding condition of the flat cables **3** and **4** is an unwound condition where a larger amount of cable is placed at the side of the outer ring wall **1***a*. Incidentally, when the cables are wound and unwound, the rollers **5** and **6** and the movable element rotatably supporting these rollers are subjected to forces exerted from the turned-back portions of the flat cables **3** and **4** and are moved in the same direction.

Next, a method of connecting the aforementioned lead block **8** and the aforesaid flat cables **3** and **4** to one another will be explained hereinbelow. As shown in FIG. **2**, the outer lead block **8** comprises a supporting element **11** made of insulating resin, and a plurality of joint bars **12** outserted to this supporting element **11**. This embodiment uses eight joint bars **12**. A through hole **11***a* is formed in the central portion of the supporting element **11**. A pair of window holes **11***b* and **11***c* are formed on the sides of the through hole **11**, respectively. Each of the joint bars **12** is bent in the supporting element **11**. Four joint bars **12** shown in the left-side part of this figure are exposed into one **11***b* of the window holes, while four joint bars **12** shown in the right-side part of this figure are exposed into the other window hole **11***c*.

In the case that the outer ends of the first and second flat cables **3** and **4** are connected to this outer lead block **8**, the flat cables **3** and **4** are connected to each other as one piece before this step of connecting the outer ends thereof to the lead block **8**. Namely, as shown in FIG. **3**, one piece of flat cable (designated by a reference character **13**, for convenience) is constituted by a belt-like element in which a pair of insulating films are laminated on a plurality of parallel conductors **13***a*. The length of this one piece of flat cable is set as being equal to a sum total of lengths of the flat cables **3** and **4**. This embodiment uses the four-circuit flat cable **13** having four conductors **13***a*. Each of the conductors **13***a* placed near the center of the flat cable **13** is exposed by removing one of the insulating films.

Further, as illustrated in FIG. **4**, the exposed portion of each of the conductors **13***a* of the flat cable **13** is made to overlap with a corresponding one of the joint bars **12** exposed into the window holes **11***b* and **11***c* provided in the outer lead block **8**. Then, the conductors **13***a* are connected to the joint bars **12** at two connection portions **14** and **15**, which are indicated by two-dot chain lines in this figure, by ultrasonic-welding or spot-welding. Thus, two joint bars **12** are connected in parallel to each of the conductors **13***a*. At that time, the connection portions **14** and **15** are away from each other at a sufficient distance in a direction in which each of the conductors **13***a* extends. Consequently, the parallelism between the conductors **13***a* and the joint bars **12** is easily calculated. Thus, the positioning of the flat cable **13** with respect to the outer lead block **8** is easily performed with high accuracy.

Thereafter, as illustrated in FIG. **5**, each of the conductors **13***a* of the flat cable **13** exposed into the through hole **11***a* provided in the outer lead block **8** is cut. At that time, a group of the joint bars **12**, which are connected in parallel to the conductors **13***a* and shown in the left-side part of this figure, are electrically independent of a group of the joint bars **12** connected in parallel to the conductors **13***a* and shown in the left-hand side part thereof. Further, the group of the joint bars **12** shown in the right-hand side part of this figure are connected to the conductors of the first flat cable **3**, respectively. The group of the joint bars **12** shown in the left-hand side part of this figure are connected to the conductors of the second flat cable **4**, respectively. In this case, it is sufficient that at least the conductors **13***a* are cut in the through hole **11***a* . If the flat cable **13** is divided into two pieces by cutting the conductors **13***a* together with the insulating films..

Thus, the outer ends of the first and second flat cables **3** and **4** are connected to the common outer lead block **8**. Thereafter, when this outer lead block **8** is fitted into and fixed to the groove provided in the holding portion **1***b*, the outer ends of the flat cables **3** and **4** are electrically led to the exterior of the stationary housing **1** through the outer lead block **8**. At that time, in the case that the joint bars **12** of the outer lead block **8** are exposed to the bottom surface of the holding portion **1***b*, the joint bars **12** serves as terminals of a connector of the direct coupling type. Thus, the rotary connector is directly connected to a connector of an external device. Alternatively, the connector connection between a dedicated connector laid at the end of a lead wire and an external device may be established by connecting a lead wire to each of the joint bars **12** through ultrasonic welding.

In the aforementioned embodiment, each of the conductors **13***a* of one piece of the flat cable **13** is connected at the two connection portions **14** and **15** to a corresponding one of the joint bars **12** of the outer lead block **8**. Subsequently, the flat cable **13** is divided into the first and second flat cables **3** and **4**, which are electrically independent of each other, by cutting each of the conductors **13***a* between these connection portions **14** and **15**. Thus, the outer lead block **8** is connected to the two flat cables **3** and **4** by once performing the positioning of the flat cables and the outer lead block. Consequently, the process of manufacturing the connectors is considerably simplified in comparison with the case that the flat cables **3** and **4** are connected to the outer lead block at different steps. Moreover, in the aforementioned embodiment, each of the conductors **13***a* is connected to a corresponding one of the joint bars **12** at the two connection portions **14** and **15** that are away from each other at a sufficient distance in the direction in which the conductors **13***a* extend. Thus, the parallelism between the conductors **13***a* and the joint bars **12** is easily calculated. Consequently, the positioning of the flat cables **13** and the outer lead block **8** is easily performed with high precision. Furthermore, in

the aforementioned embodiment, the outer lead block **8** is not divided even after the flat cables **3** and **4** are connected thereto. Thus, the flat cables and the outer lead block are treated as a single unit. Consequently, the operation of fixing the outer lead block **8** to the stationary housing **1** at a predetermined place is achieved at a time.

Incidentally, the foregoing description of the embodiment has described the case that, even after both the flat cables **3** and **4** are connected to the outer lead block **8**, this block is not divided and these flat cables and lead block are integral with one another. However, when the one piece **13** of flat cable is divided into the two pieces **3** and **4** of flat cable, the outer lead block may be cut and divided into two pieces, similarly as the one piece **13** of flat cable. In this case, the two pieces of the divided outer lead block **8** are finally connected to the outer ends of the flat cables **3** and **4**, respectively. Thus, the two flat cables **3** and **4** are connected to the outer lead block **8** by performing the positioning thereof only once, similarly as in the aforementioned embodiment. Consequently, the process of manufacturing the connectors is substantially simplified in comparison with the case that the flat cables **3** and **4** are connected to the outer lead blocks at different steps.

Additionally, the foregoing description of the embodiment has described the case that the present invention is applied to the connection portions between the outer lead block **8** and each of the flat cables **3** and **4**. The present invention, however, may be applied to the connection portions between the flat cables **3** and **4** and the inner lead blocks **9** and **10**. In this case, the space, in which the inner lead blocks **9** and **10** are placed, at the side of the inner ring wall **2***a* is narrower than the space, in which the outer lead block **8** is placed, at the side of the outer ring wall **1***a*. Thus, it is preferable for increasing the degree of flexibility in placing the lead block that, when the one piece **13** of flat cable is divided into the two flat cables **3** and **4**, the lead block to be connected thereto is divided into the two inner lead blocks **9** and **10**.

The present invention is implemented by the aforementioned embodiment and has the following advantageous effects.

Necessary two flat cables are preliminarily connected to each other into one flat cable. Then, the conductors provided on this flat cable are connected to the joint bars of the lead block at the two connection portions provided in the direction in which the conductors extend. Subsequently, the conductors are cut between these connection portions and are divided into those provided on the two flat cables that are electrically independent of each other. Thus, the lead block is connected to the two flat cables by performing the positioning thereof only once. Consequently, the process of manufacturing the entire rotary connector is simplified. Moreover, the positioning of the flat cables and the lead block is easily achieved with high accuracy, because the flat cables and the lead block are positioned at the two connection portions that are away from each other in the direction in which the conductors extend.

Although the preferred embodiment of the present invention has been described above, it should be understood that the present invention is not limited thereto and that other modifications will be apparent to those skilled in the art without departing from the sprint of the invention.

The scope of the present invention, therefore, should be determined solely by the appended claims.

What is claimed is:

1. A rotary connector comprising:

a pair of housings, coaxially and relatively rotatably connected to each other;

two flat cables accommodated in a space defined between said housings; and

a lead block fixed to said housings,

wherein at least one end portion of each of conductors of said flat cables is led to the exterior of said housings through joint bars supported by said lead block, and

wherein a single flat cable is divided into said two flat cables, which are electrically independent of each other, by first providing said joint bars, the number of which is more than that of said conductors of a single flat cable, on said common lead block, and then connecting said conductors of said single flat cable to said joint bars at two connection portions placed in a direction in which said conductors extend, and subsequently, cutting said conductors between said connection portions.

2. The rotary connector according to claim **1**, wherein each of said common lead block and said single flat cable is divided into two pieces by cutting said conductors.

3. The rotary connector according to claim **1**, wherein said common lead block is maintained as one piece even after said conductors are cut.

4. The rotary connector according to claim **1**, wherein, in each of said connection portions on a side of each of which said joint bars are connected to said conductors of said flat cables, insulating film of each of said two flat cables is left on an opposite side of each of said connection portions.

5. The rotary connector according to claim **2**, wherein, in each of said connection portions on a side of each of which said joint bars are connected to said conductors of said flat cables, insulating film of each of said two flat cables is left on an opposite side of each of said connection portions.

6. The rotary connector according to claim **3**, wherein, in each of said connection portions on a side of each of which said joint bars are connected to said conductors of said flat cables, insulating film of each of said two flat cables is left on an opposite side of each of said connection portions.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 6,109,942
DATED : August 29, 2000
INVENTOR(S) : Hiroyuki Bannai

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Title page,
ABSTRACT,
Column 2, line 9, insert -- the -- before "conductors".

Claim 1,
Line 7, insert -- the -- before "conductors".

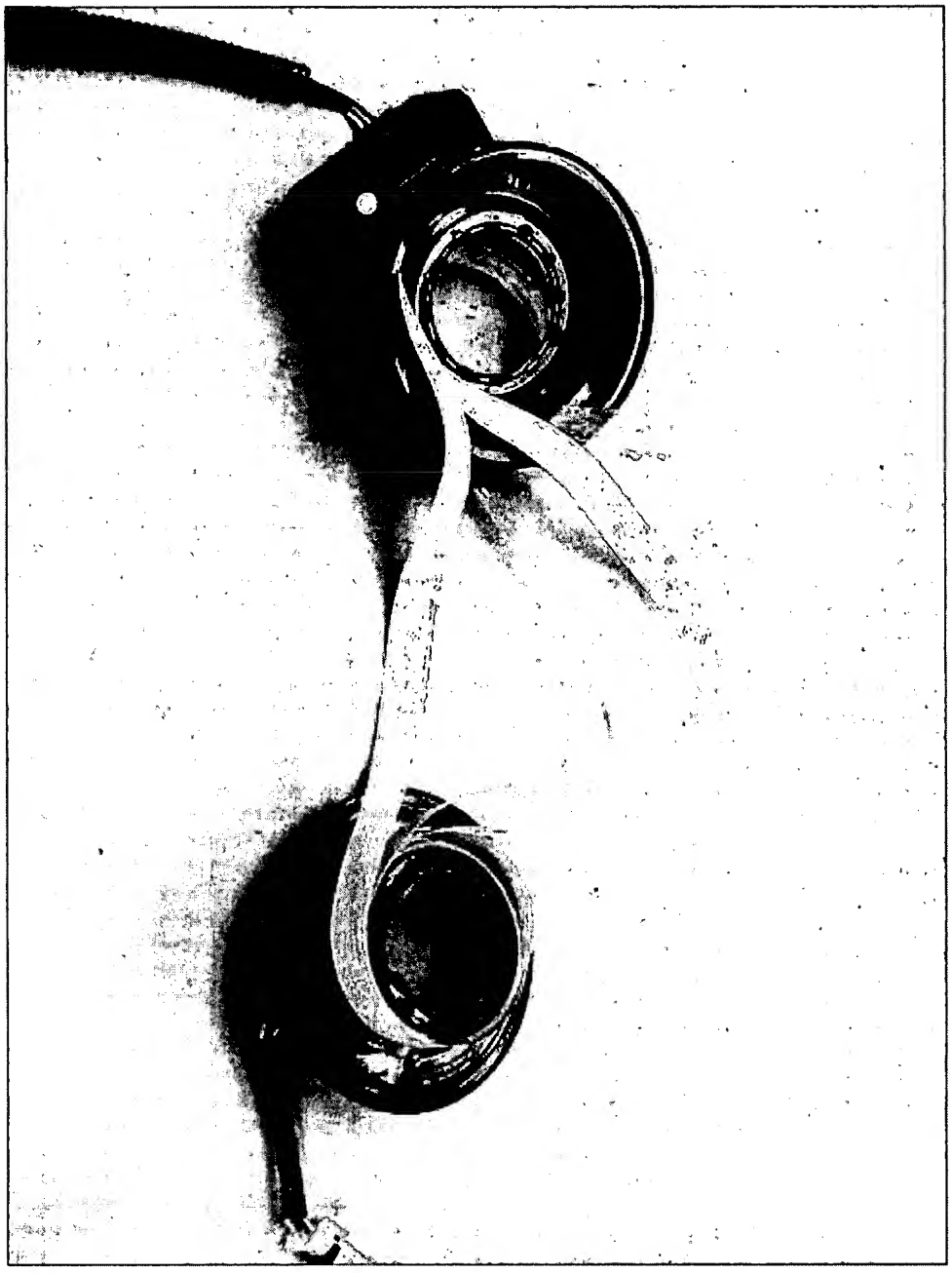
Signed and Sealed this

Twenty-sixth Day of March, 2002

Attest:

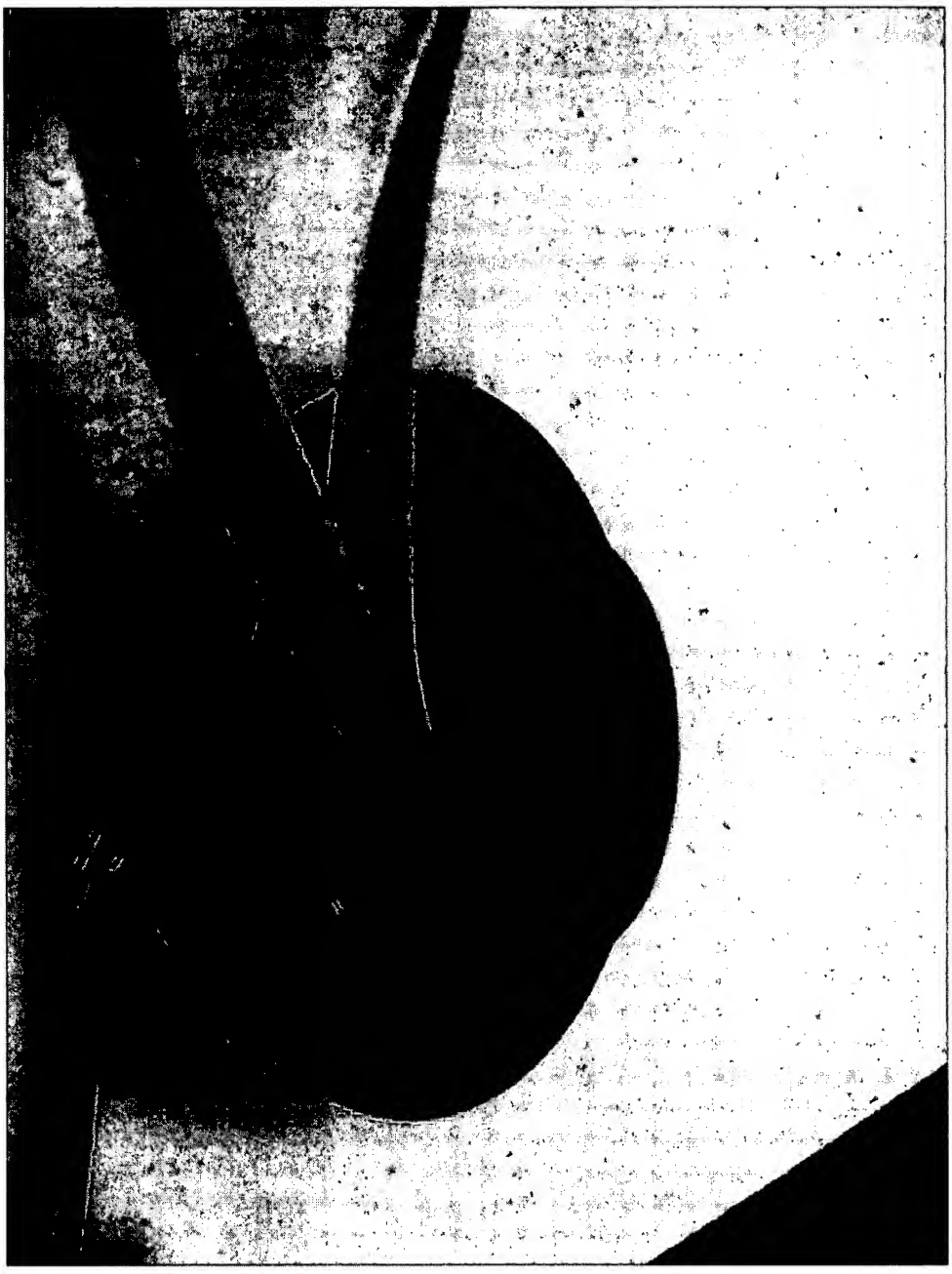
Attesting Officer

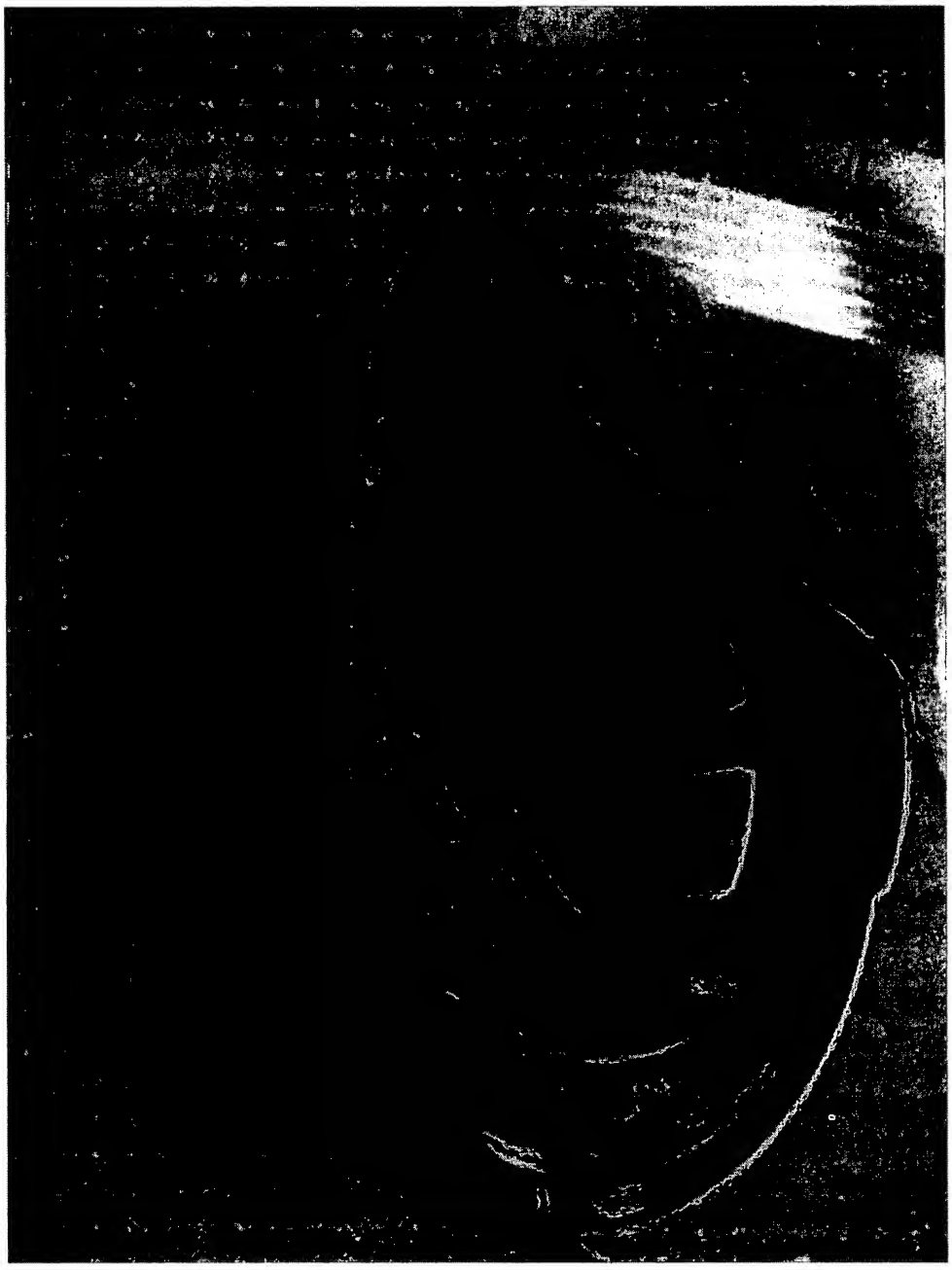
JAMES E. ROGAN
Director of the United States Patent and Trademark Office



EXHIBIT

C1





EXHIBIT

C2

EXHIBIT

C3